

2.2. Newly added claims 37 to 43 are based on the Examples listed below with the appropriate values for the CCS test being taken from Table 1 on page 3 of the specification.

Claim Example

37	12
38	13
39	14
40	15
41	17
42	18
43	20

The finished oils of these Examples all contain basestocks ("B" basestocks) which have been dewaxed to a pour point between -30° to -45°C, as stated in the comments to Table 8 on page 32 of the specification, so that it is in order for these claims to so refer to the basestock oils.

3.1. All claims in the application have been rejected under 35 USC 103(a) in view of Trewella, U.S. 6,090,089. Trewella describes paraffinic hydrocarbons suitable for use as lubricant basestocks. The hydrocarbons are wax isomerates which are characterized by the extent of chain branching, as measured by (i) the percentage of methyl hydrogens (BI) and (ii) the proximity of branching, as measured by the percentage of recurring methylene carbons which are four or more carbons removed from an end group or branch ($\text{CH}_2>4$). The characterization is in conformance with the requirements set out in claim 1, i.e.:

- (a) BI - $0.5(\text{CH}_2>4) > 15$; and
- (b) BI + $0.85(\text{CH}_2>4) < 45$.

3.2. These hydrocarbon basestocks may contain conventional type additives in order to formulate a finished oil (col. 3, ll. 50-57). Other basestock components such as esters and poly-alpha olefins may be blended with the wax isomerate to form the finished lubricant (col. 5, ll. 37-42). The performance of these wax isomerates as lubricant compositions is referred to in column 6, lines 1 to 15, where it is stated that the basestocks have extremely low pour points which, notably, may preferably be lower than -40°C (col. 6, l. 3) with high viscosity indices from 130 to 165. Trewella makes no reference to the biodegradability of these hydrocarbons or of lubricants produced from them.

3.3. The examiner has rejected all the claim of the application stating that "Trewella encompasses the liquid lubricant compositions of applicant's claims". The significance of the biodegradability requirement (at least 50% by OECD 301B) is dismissed in a conclusion which states that "the paraffinic basestock of the prior art may be the same as applicants paraffinic basestock, so the biodegradability may be the same". (Paper No., 7, page 3)

4.1. Applicant dissents from the Examiner's conclusion. The present claims are directed to lubricant compositions which are formulated using paraffinic basestocks which may be within the scope of the Trewella disclosure but which form a more limited sub-class within the broader class described by Trewella. The paraffinic wax isomerates used in the presently claimed lubricant compositions are defined in terms which include their viscosity index and their pour point, both of which jointly contribute to the production of finished lubricant compositions which have properties - including biodegradability - which are not found in nor reasonably could have been predicted from the Trewella disclosure.

4.2. First, the choice of a limited range of pour points for the wax isomerate, from -25° to -55°C (as set out on page 13, line 2 of the text) is significant in terms of the properties of the finished lubricant and is, for the reasons set out below, contrary to the expectation of what would be expected for best low temperature performance. The skilled lubricant formulator would normally and logically select the basestock with the lowest pour point for best low temperature performance in the finished lubricant. Instead, however, the finished lubricant with the best low temperature performance is made using a basestock which has a rather *higher* pour point. This is shown in Examples 11 and 12 with respect to 0W-20 oils. The properties of the basestocks and the finshed oils are set out below in Table 1, using data taken from Tables 8 and 11 of the specification.

Table 1

Formulation Component, Wt.%	Ex. 11	Ex. 12
Wax Isomerate A-1, Pour Point -66°C	64.1	
Wax Isomerate B-2, Pour Point -40°C		64.1
Co-Base Oil (Ester/Aromatic)	20.0	20.0
PCEO DDI (Additives)	15.9	15.9
Performance		
SAE Viscosity Grade	0W-20	0W-20
KV @ 100°C (cSt)	6.25	6.60
CCS @ -30°C (cP)	2570	2490
HTHS @ 150°C (cP)	2.14	2.35
Pour Point (°C)	-54	-51
MRV @ -40°C (cP/Pa)	9580/<35	8660/<35

Here are two oil formulations made with two basestocks of similar origin (wax isomerates) but with differing pour points, namely, of -66°C and -40°C. The normal expectation of the skilled lubricant formulator would be that the basestock with the *lower* pour point would result in a finished oil with better low temperature performance, for example, a lower formulation pour point, and lower viscosity at low temperatures. This, however, is not what is obtained: the oil made from the basestock with the lower pour point (A-1, -66°C) has a slightly *higher* pour point than the oil made with the basestock of higher point (B-2, -40°C). More notably, however, is that the oil of Example 12 has a significantly lower CCS value than the oil of Example 11, again illustrating the advantage of selection of basestock not by the lowest achievable pour point but by appropriate and judicious application of the appropriate criteria.

4.3. This finding is replicated in Examples 16 and 18 for 0W-40 formulations, with the relevant data shown below in Table 2, with data taken from Table 13 of the specification.

Table 2

Formulation Component, Wt.%	Example 16	Example 18
Styrene-Isoprene Polymer	1.4	1.4
Wax Isomerate A-1, Pour Point -66°C	62.7	
Wax Isomerate B-1, Pour Point -34°C		62.7
Co-Base Oil (Ester/Aromatic)	20.0	20.0
PCEO DDI (Additives)	15.9	15.9
Performance		
SAE Viscosity Grade	0W-40	0W-40
KV @ 100°C (cSt)	12.7	13.5
CCS @ -30°C (cP)	3150	2800
HTHS @ 150°C (cP)	3.54	3.70
Pour Point (°C)	-56	-48
MRV @ -40°C (cP/Pa)	18370/<35	16800/<35

Here, the differential for finished oil performance is even more striking: the two basestocks have widely differing pour points and yet, when formulated into otherwise identical finished lubricants, the basestock with the much lower pour point (Example 16) results in a finished oil with a significantly *higher* CCS and a much *higher* MRV, even though the lower pour point of the oil is carried through to the finished oil although to a diminished extent. These lower values of viscosity are of significance in the formulation of the finished oil because, as explained in the specification, the CCS represents the power required to crank the engine containing the cold oil (lower values are better) and the MRV is representative of the viscosity that the oil achieves under conditions of low temperature and low shear, a pumpability criterion, again related to cold start characteristics.

4.5. This property inheres to some extent in the basestock as shown by the comparison in Table 3 below which is drawn from Table 10 of the specification:

Table 3

Basestock	Pour Point (°C)	MRV Viscosity (-30°C, cP)	CCS Viscosity (-30°C, cP)
A-3	-60	3060	3060
B-3	-37	2730	2350
C-2	-26	3050	2240
D-3	-18	9210	2110

These data show that there is a definite minimum in the values of the MRV for the basestocks with the intermediate values of pour point (compare basestock B-3 with A-3 and C-2). Note also that basestock A-3 has a higher CCS than basestocks B-3 and C-2 which both have higher pour point.

4.6. So, what applicant has done here is to select a limited group of the basestocks falling within the scope of Trewella's broad disclosure and determine which are the most apt to make finished oils of good low temperature performance, as measured by standard industry tests. The characteristic selected is the pour point of the basestock and it is selected in a counter-intuitive manner in which there is a definite minimum pour point which is to be followed for best oil performance.

5. There is also a second factor which is unexpected. It is this: there is an optimum range of viscosity indices for the basestocks which is to be observed for optimal oil performance. While Trewella contemplates the possibility of oils with viscosity indices as high as 165 there is a definite optimal range for this parameter with a maximum of but 160. As reported on page 12 of the specification, the MRV viscosity of the oil (a low temperature performance parameter) deteriorates if the VI exceeds 160. Trewella however, indicates no preference for a limitation on this, a very important property of the basestock.

6. Thirdly, there is an inverse correlation between the viscosity index of the oil and the biodegradability. The biodegradability of paraffinic hydrocarbons is dependent upon a number of factors, of which one - a major one - is the chain branching characteristic: linear hydrocarbons are more biodegradable than branched chain hydrocarbons. This implies that the wax isomerate hydrocarbon basestocks with lower pour points would be expected, other factors being the same, to have worse biodegradabilities than basestocks of higher pour point because the pour point of paraffinic hydrocarbons is dependent on the linearity of the hydrocarbons, with low pour points associated with the higher degree of chain branching of the iso-paraffins as opposed to the higher biodegradability of the high pour point, more linear paraffins. PAOs which are made up of branched chain paraffins have excellent low pour points but in general terms are less biodegradable than the paraffins of higher pour point which contain hydrocarbons of a more linear structure. See, for example, U.S.

5,595,966 (cited). While Trewella states nothing about biodegradability, it is unexpected that oils with good biodegradability (correlated with linear paraffinic structure) may be produced while retaining good low temperature performance including low pour point (correlated with iso-paraffinic structure) and high viscosity index (correlated again with iso-paraffin structure). Trewella gives no hint or suggestion that such a result might have been expected or possible.

7.1. On the basis of these considerations, it is submitted that there is an unexpected character to the presently claimed lubricants: the finished oils containing the additive package in addition to the basestock do not behave in conformance with the basestock properties. In fact, they have been shown to behave in a manner which is the opposite of what might have been expected from a knowledge of the basestock properties. It is therefore believed that the presently claimed lubricant compositions would not have been obvious to the person of ordinary skill in the art under 35 USC 103.

7.2. The Examiner's conclusion that obviousness is to be founded upon the fact that Trewella "encompasses" the present compositions is believed to be misplaced. The test for obviousness under Section 103 is whether the invention as a whole - the formulation and its properties would have been obvious to the skilled person. The fact that it may fall within a previously known and larger class of materials is not the appropriate standard: *In re Benno* 768 F.2d 683, 226 U.S.P.Q. 1340 (Fed. Cir. 1985). Further, the fact that the biodegradability of the Trewella hydrocarbons "may" be the same is not relevant because Trewella does not disclose the selection of an appropriately limited class or group of wax isomerates for lubricant formulation nor does Trewella suggest criteria by which finished formulations which possess unexpected combinations of properties might be selected. Since the wax isomerates which may be used as the basestocks for the presently claimed formulations may certainly conform to Trewella's prescriptions for the larger class to which these hydrocarbons belong (as is admitted) it is possible that an appropriate choice of basestock from the broader class encompassed by Trewella would result in the same biodegradability when formulated into a finished lubricant but the point is that the appropriate selection has to be made in accordance with the teachings of the present invention and specification which are just not found in Trewella. Being, moreover, counter

intuitive to the skilled person for the reasons set out above, the presently claimed formulations would not have been obvious to the skilled lubricant formulator under the standards of 35 USC 103, properly applied.

8. In view of the remarks and amendments set out above, reconsideration and withdrawal of the rejection are requested.

Respectfully submitted,



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1. A liquid lubricant composition, comprising
(i) a paraffinic biodegradable hydrocarbon basestock component having a biodegradability of at least 50% (OECD 301B) and having a pour point of from about -25°C -25°C to -55°C or lower and a viscosity index of 130 to 160, in which the extent of branching, as measured by the percentage of methyl hydrogens (BI), and the proximity of branching, as measured by the percentage of recurring methylene carbons which are four or more carbons removed from an end group or branch ($\text{CH}_2>4$), are such that:

- (a) BI - $0.5(\text{CH}_2>4)$ > 15; and
- (b) BI + $0.85(\text{CH}_2>4)$ < 45;

as measured over said hydrocarbon basestock as a whole, and

(ii) additives soluble in the basestock comprising a detergent and an antioxidant, the liquid lubricant composition having a CCS viscosity at -15°C of not more than about 3500 cP and a kinematic viscosity at 100°C of not less than about 5 cSt.

2. The liquid lubricant composition of claim 1, wherein a combination of dynamic viscosity (DV), as measured by CCS viscosity at -40°C, and kinematic viscosity, as measured at 100°C, of said paraffinic biodegradable hydrocarbon basestock is:

$$\text{DV}_{@-40^\circ\text{C}} < 2900(\text{KV}_{@100^\circ\text{C}}) - 7000.$$

3. The liquid lubricant composition of claim 1, wherein MRV viscosity as measured at -30°C of said paraffinic biodegradable hydrocarbon basestock is not more than about 60,000 cP, with a yield stress of not more than about 35 cP.

4. The liquid lubricant composition of claim 3, wherein MRV viscosity as measured at -40°C of said paraffinic biodegradable hydrocarbon basestock is not more than about 60,000 cP, with a yield stress of not more than about 35 cP.

5. ~~The liquid lubricant composition of claim 1, wherein viscosity index of said paraffinic biodegradable hydrocarbon basestock is about 160 or less.~~

6. The liquid lubricant composition of claim 15, wherein the viscosity index of said paraffinic biodegradable hydrocarbon basestock is from about 140 to about 160.

7. The liquid lubricant composition of claim 1, wherein the pour point of said paraffinic biodegradable hydrocarbon basestock is less than about -30°C.

8. The liquid lubricant composition of claim 7, wherein MRV viscosity as measured at -35°C of said paraffinic biodegradable hydrocarbon basestock is not more than about 60,000 cP, with a yield stress of not more than about 35 cP.

9. The liquid lubricant composition of claim 7, wherein viscosity index of said paraffinic biodegradable hydrocarbon basestock is from about 140 to about 160.

10. The liquid lubricant composition of claim 7, wherein the pour point of said paraffinic biodegradable hydrocarbon basestock is from about -30°C to about -45°C.

11. The liquid lubricant composition of claim 1, wherein the pour point of said lubricant composition is less than about -20°C.

12. The liquid lubricant composition of claim 11, wherein the pour point of said lubricant composition is less than about -30°C.

13. The liquid lubricant composition of claim 11, wherein the pour point of said lubricant composition is from about -35°C to about -60°C.

14. The liquid lubricant composition of claim 1 which conforms to SAE 0W low-temperature viscosity grading, and which has CCS viscosity at -30°C of not more than 3250 cP, and MRV viscosity at -40°C of not more than 60,000 cP.

15. The liquid lubricant composition of claim 14 further comprising a polymeric viscosity modifier.

16. The liquid lubricant composition of claim 15 which conforms to

SAE 0W-40 grading and which has a kinematic viscosity at 100°C of from 12.5 cSt to less than 16.3 cSt, comprising from about 0.05 to 30 wt% of the polymeric viscosity modifier and wherein the paraffinic biodegradable hydrocarbon basestock has a kinematic viscosity at 100°C of from about 3.5 cSt to about 5.0 cSt.

17. The liquid lubricant composition of claim 16 having a pour point no higher than about -40°C.

18. The liquid lubricant composition of claim 15 which conforms to SAE 0W-30 grading and which has a kinematic viscosity at 100°C of from 9.3 cSt to less than 12.5 cSt, comprising from about 0.01 to about 25 wt% of the polymeric viscosity modifier and wherein the paraffinic biodegradable hydrocarbon basestock has a kinematic viscosity at 100°C of from about 3.5 to about 5.0 cSt.

19. The liquid lubricant composition of claim 18 having a pour point no higher than about -40°C.

20. The liquid lubricant composition of claim 19 having a CCS viscosity at -30°C of not more than about 3000 cP.

21. The liquid lubricant composition of claim 1 which conforms to SAE 5W low-temperature viscosity grading, and which has CCS viscosity at -25°C of not more than 3500 cP, and MRV viscosity at -35°C of not more than 60,000 cP.

22. The liquid lubricant composition of claim 21 further comprising a polymeric viscosity modifier.

23. The liquid lubricant composition of claim 1 which conforms to SAE 10W low-temperature viscosity grading, and which has CCS viscosity at -20°C of not more than 3500 cP, and MRV viscosity at -30°C of not more than 60,000 cP.

24. The liquid lubricant composition of claim 23 further comprising a polymeric viscosity modifier.

25. The liquid lubricant composition of claim 1 which conforms to SAE 15W low-temperature viscosity grading, and which has CCS viscosity at -15°C of not more than 3500 cP, and MRV viscosity at -25°C of not more than 60,000 cP.

26. The liquid lubricant composition of claim 25 further comprising a polymeric viscosity modifier.

27. The liquid lubricant composition of claim 26 which conforms to SAE 15W-50 viscosity grading and which has a kinematic viscosity at 100°C of from 16.3 cSt to less than 21.9 cSt, comprising from about 0.1 to about 25 wt% of the polymeric viscosity modifier and wherein the paraffinic biodegradable hydrocarbon basestock has a kinematic viscosity at 100°C of from about 5.5 cSt to about 14.0 cSt.

28. The liquid lubricant composition of claim 27 having a pour point no higher than about -35°C.

29. The liquid lubricant composition of claim 28 having a CCS viscosity at -30°C of not more than about 3300 cP.

30. The liquid lubricant composition of claim 1 which conforms to SAE "xW-y" viscosity grading, where $x = 0, 5, 10, \text{ or } 15$, and where $y = 10, 20, 30, \text{ or } 40$, and where $(y - x)$ is less than or equal to 25.

31. The liquid lubricant composition of claim 1, wherein said paraffinic hydrocarbon components have BI greater than 26.1 and $\text{CH}_2 > 4$ less than 22.2.

32. The liquid lubricant composition of claim 1 further comprising a lubricating oil basestock component comprising an ester or an alkylated aromatic or mixtures thereof.

33. The liquid lubricant composition of claim 32 wherein the ester is an ester of a polyol alcohol and a monocarboxylic acid having a kinematic viscosity at 100°C of about 2 cSt to about 8 cSt, and the alkylated aromatic is an alkyl naphthalene having a

mono alkyl substituent group of about 10 to about 20 carbon atoms having a kinematic viscosity at 100°C of about 2 cSt to about 8 cSt.

34. The liquid lubricant composition of claim 32 having from about 5 wt% to about 20 wt% of the ester or alkylated aromatic or mixture thereof.

35. The liquid lubricant composition of claim 1 wherein the antioxidant is an aromatic amine or an alkylated phenol or mixtures thereof.

36. The liquid lubricant composition of claim 1 wherein the detergent is an alkali or alkaline earth sulfonate, or an alkali or alkaline earth salicylate, or alkali or alkaline earth phenate, or mixtures thereof.